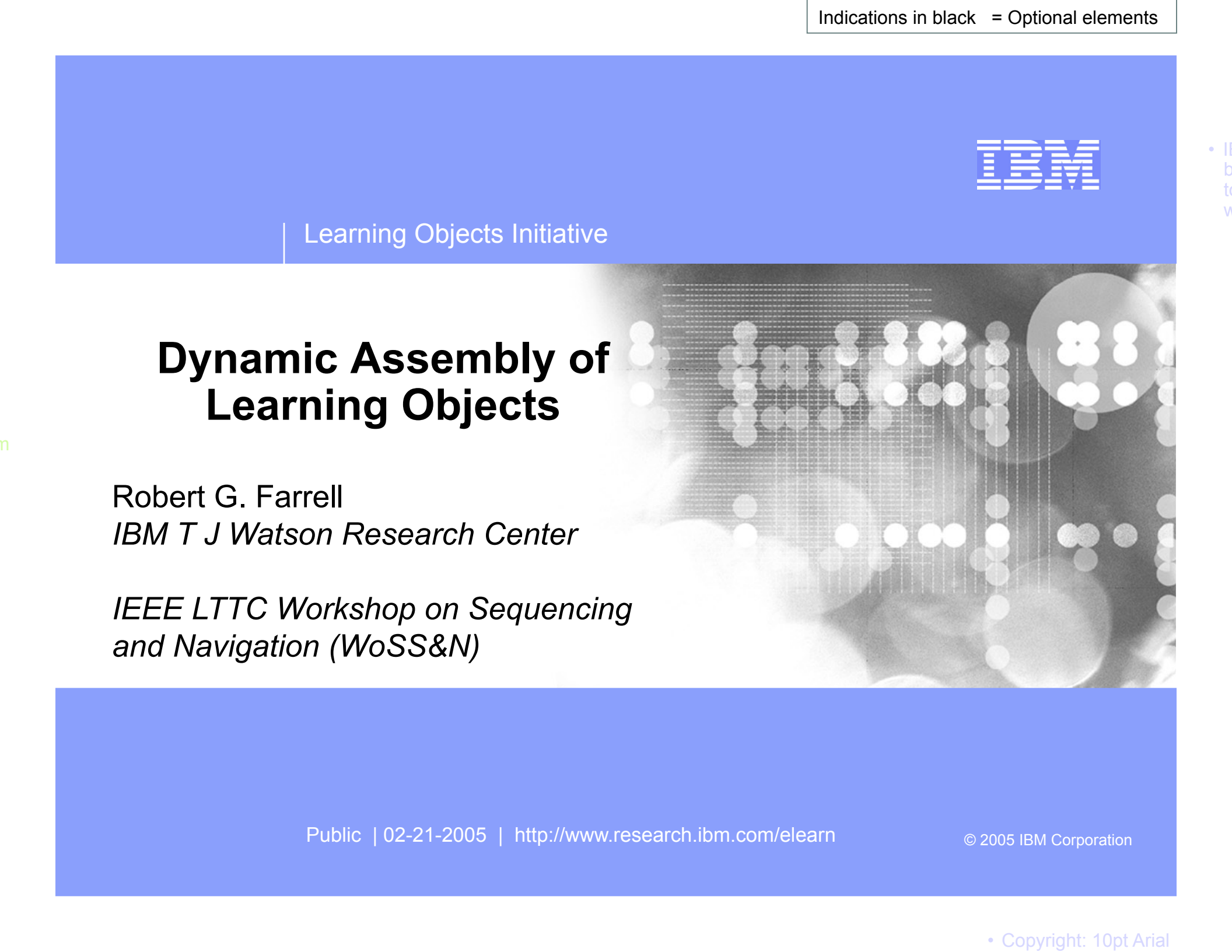
Indications in black = Optional elements



Learning Objects Initiative

Dynamic Assembly of Learning Objects

Robert G. Farrell
IBM T J Watson Research Center

IEEE LTTC Workshop on Sequencing and Navigation (WoSS&N)

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Outline

- Overview
- The Dynamic Learning Experience (DLE) System
- The Dynamic Assembly process
- Pilot Studies and Evaluation
- Learning Content Development for DLE
- Conclusions

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Motivation

- **Adult learners** are highly motivated to educate themselves on new, job-relevant information.
- Instead of taking web-based training courses, these learners ask experts, search databases, and scan through technical documents to **quickly learn what they need to know.**

- However, for learners new to a subject, information is often **difficult to find and organize information for effective learning**. Knowledge acquired is often disconnected, forgotten, or **not effectively integrated into practice**.

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Approach

- **Modularization** – Create or quickly extract learning objects that achieve a focused objective quickly.
- **Dynamic Assembly** – Enable users to dynamically assemble learning objects into short, focused sequences.
- **Customization** – Allow learners to customize these sequences to fit their immediate needs or the needs of others in the context of work, assignments, or other motivating factors.
- **Sharing** – Allow learners and more knowledgeable peers to easily share these sequences (called “custom courses”).

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Benefits

- **Motivation** - *Self-directed learners are often more motivated*. Creating courses to meet their individual needs involves learners in the process and may increase job satisfaction as employees feel both *trusted* and *enabled to learn on the job*.

- **Effectiveness** – Courses created dynamically can be sized to address the *precise learning gap* to the extent that the learner or a team member is aware of the learner's needs.

- **Relevance** – Much of the information in e-learning courses is inapplicable to a given individual. Learners often find it difficult to navigate through and skip the information they don't need. Individualized courses solve this problem by *focusing the learner on a small set of resources* relevant to a given topic.

- **Timeliness** - Users may need access to content before it is found in classroom or online courses designed by professional instructors. This approach provides a *fast way to assemble reference material* authored by subject matter experts, mentors, leaders, or knowledgeable peers.

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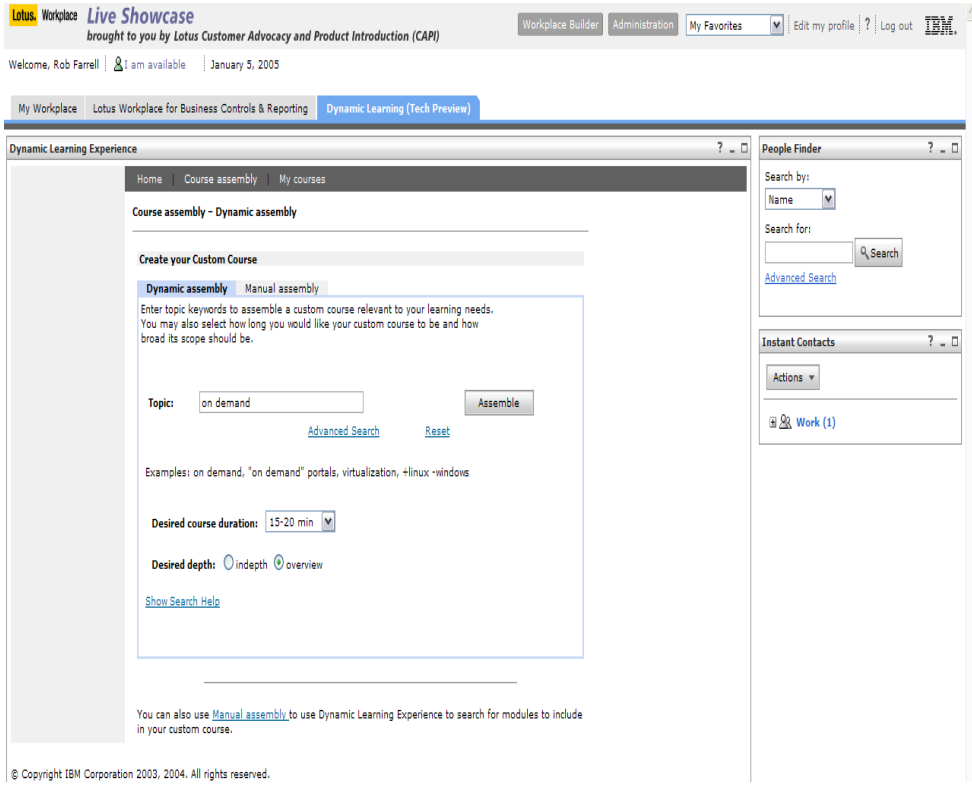
Dynamic Learning Experience



- *a Tech Preview portlet for IBM Lotus Workplace ™*
- *Winner of Brandon Hall "Excellence in Learning" Award for Innovative Technology*

http://www.alphaworks.ibm.com/tech/dle

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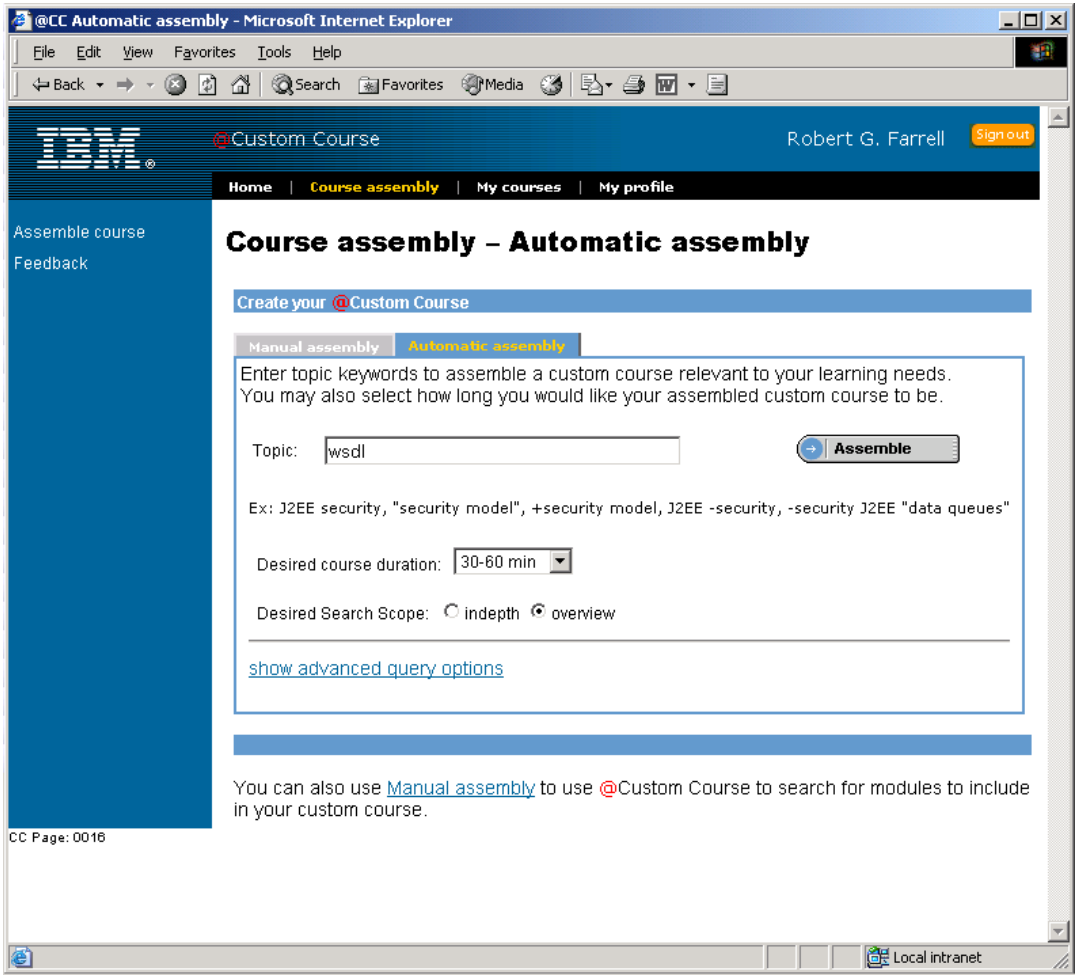
Dynamic Assembly Query and Preferences



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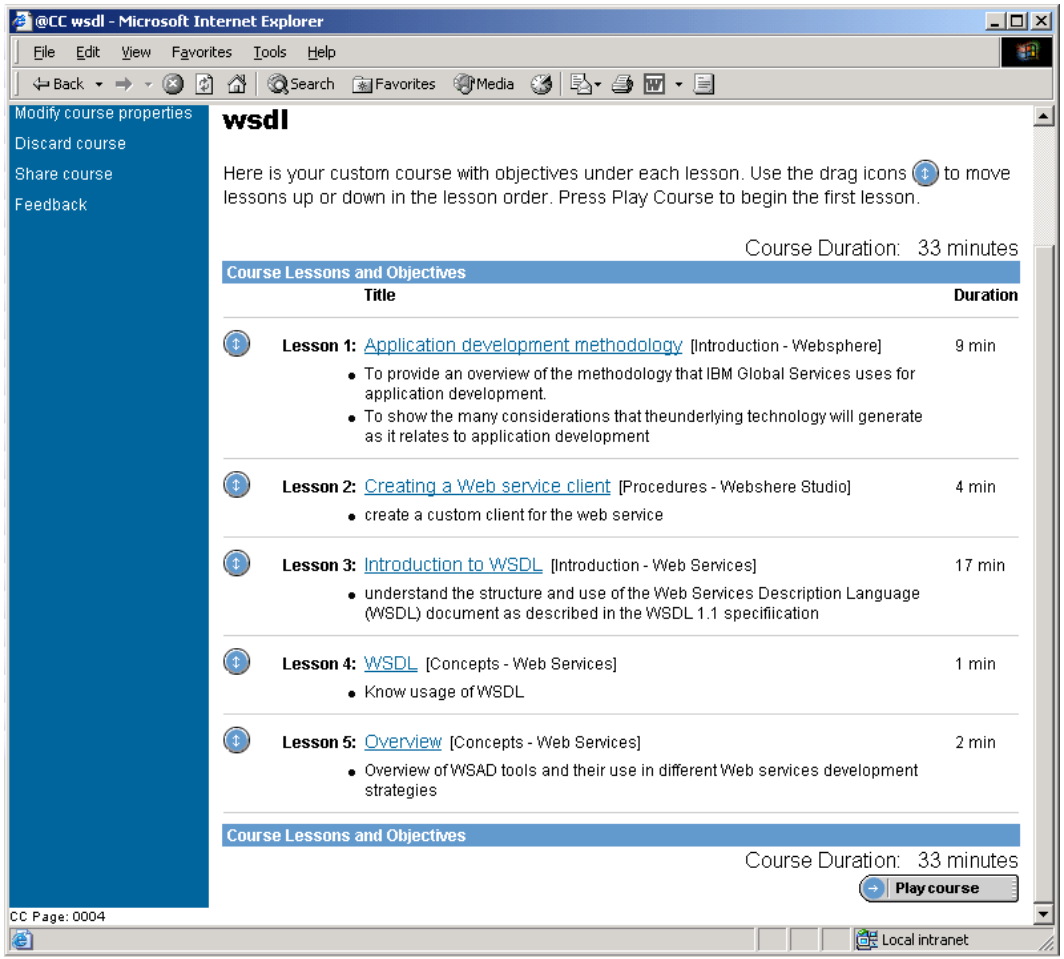
A Sequence of Learning Objects



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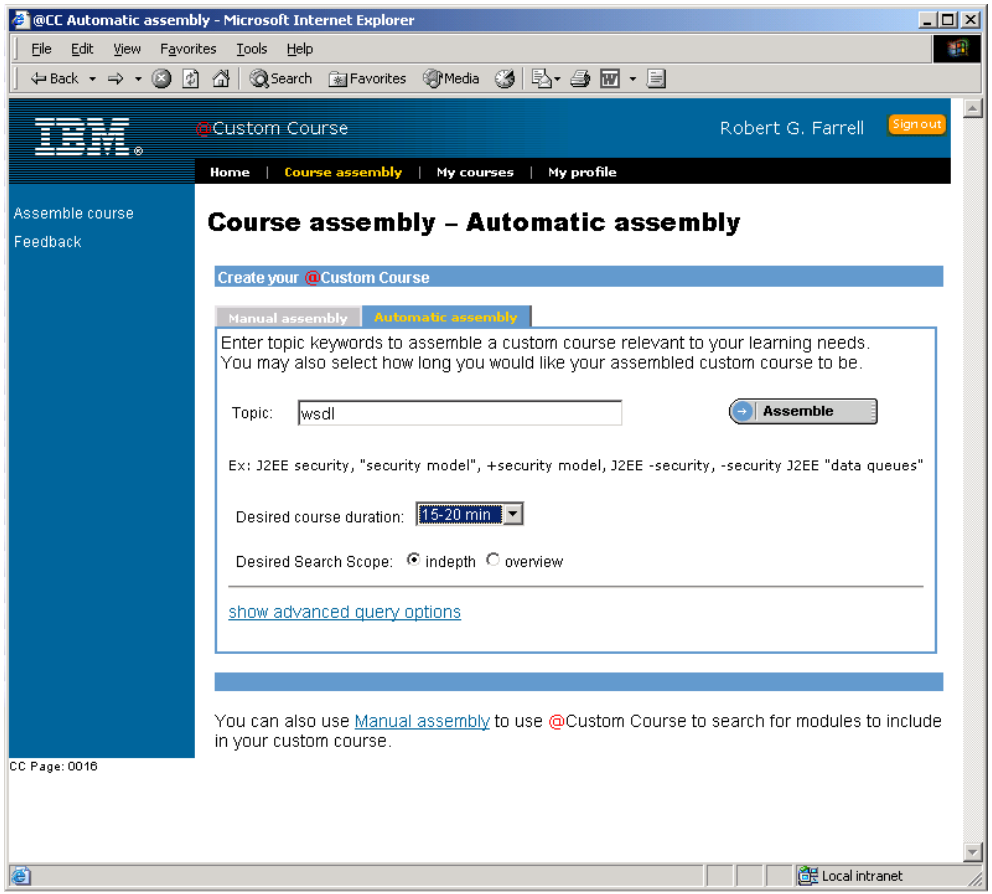
Given Different Preferences for the Same Query



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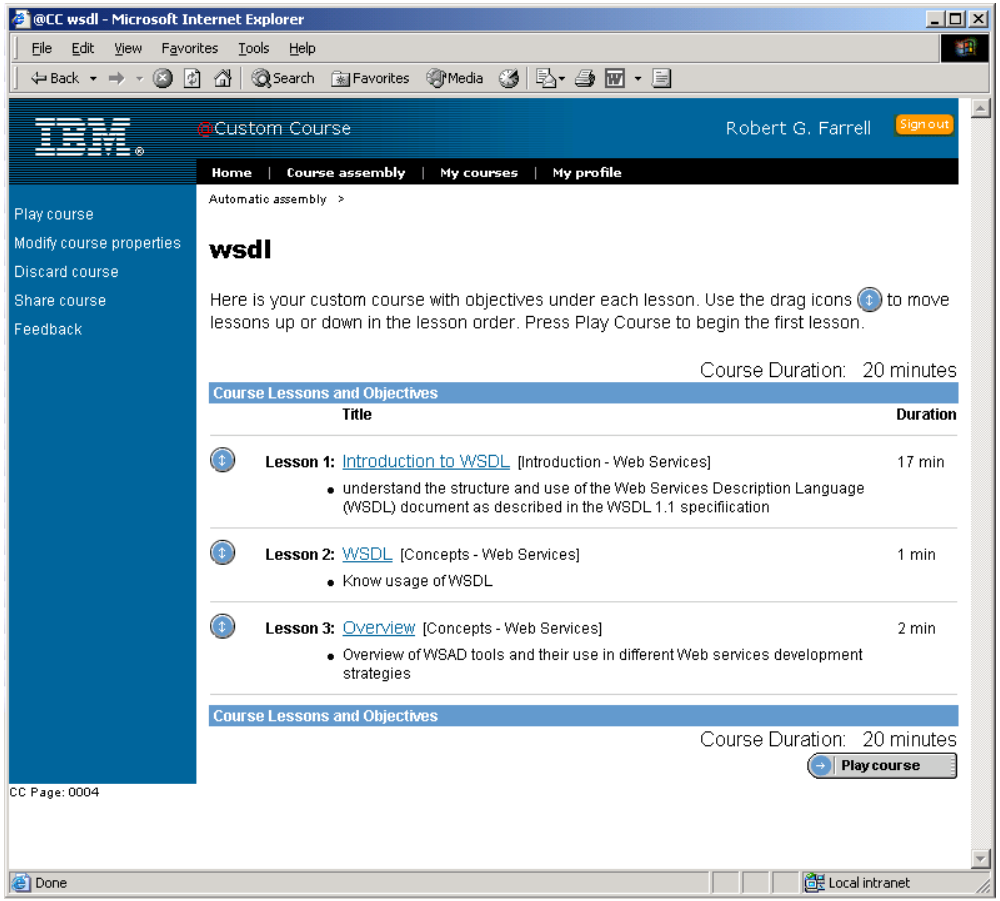
A Different Sequence is Generated



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The Dynamic Assembly Problem

- Given: a **topic query**
  - AND -
  a set of **preferences**
  and **constraints**

Example:

topic: "wsdl"

depth: overview

duration: 30-60 min.

- Output:
  A **coherent organization** of learning objects with a logical progression

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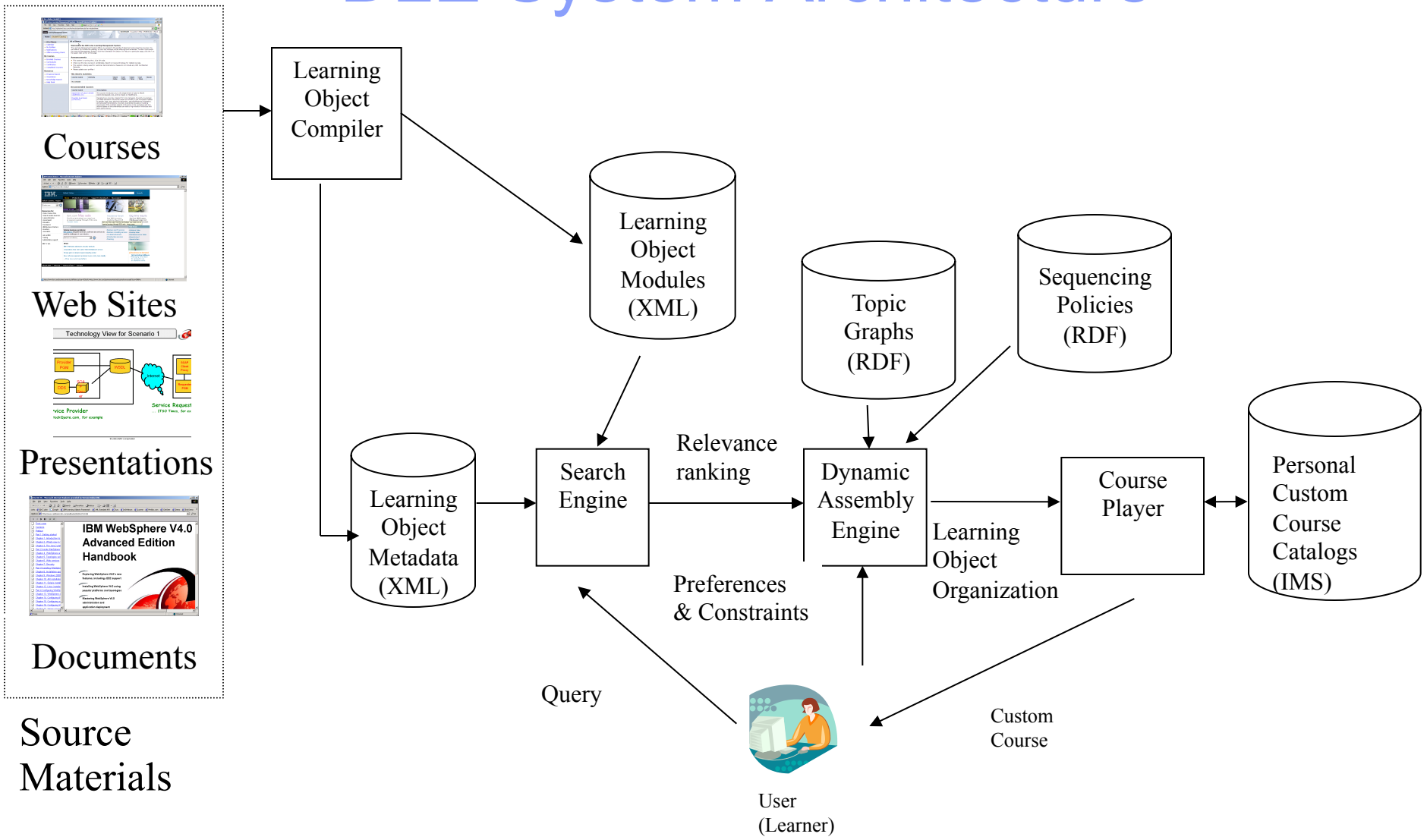
DLE System Architecture



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Example

Search results

Introduction to WSDL

WSDL Primer

Service-oriented architecture

Creating a Web service from WSDL

Application Development Methodology

Creating a Web service client

Overview of Web services: WSDL

Design Guidelines for Web services

Coherent Sequence of Related Results

Introduction to WSDL

WSDL Primer

Creating a Web service from WSDL

Overview of Web services: WSDL

Application Development Methodology

Service-oriented architecture

Creating a Web service client

Design Guidelines for Web services

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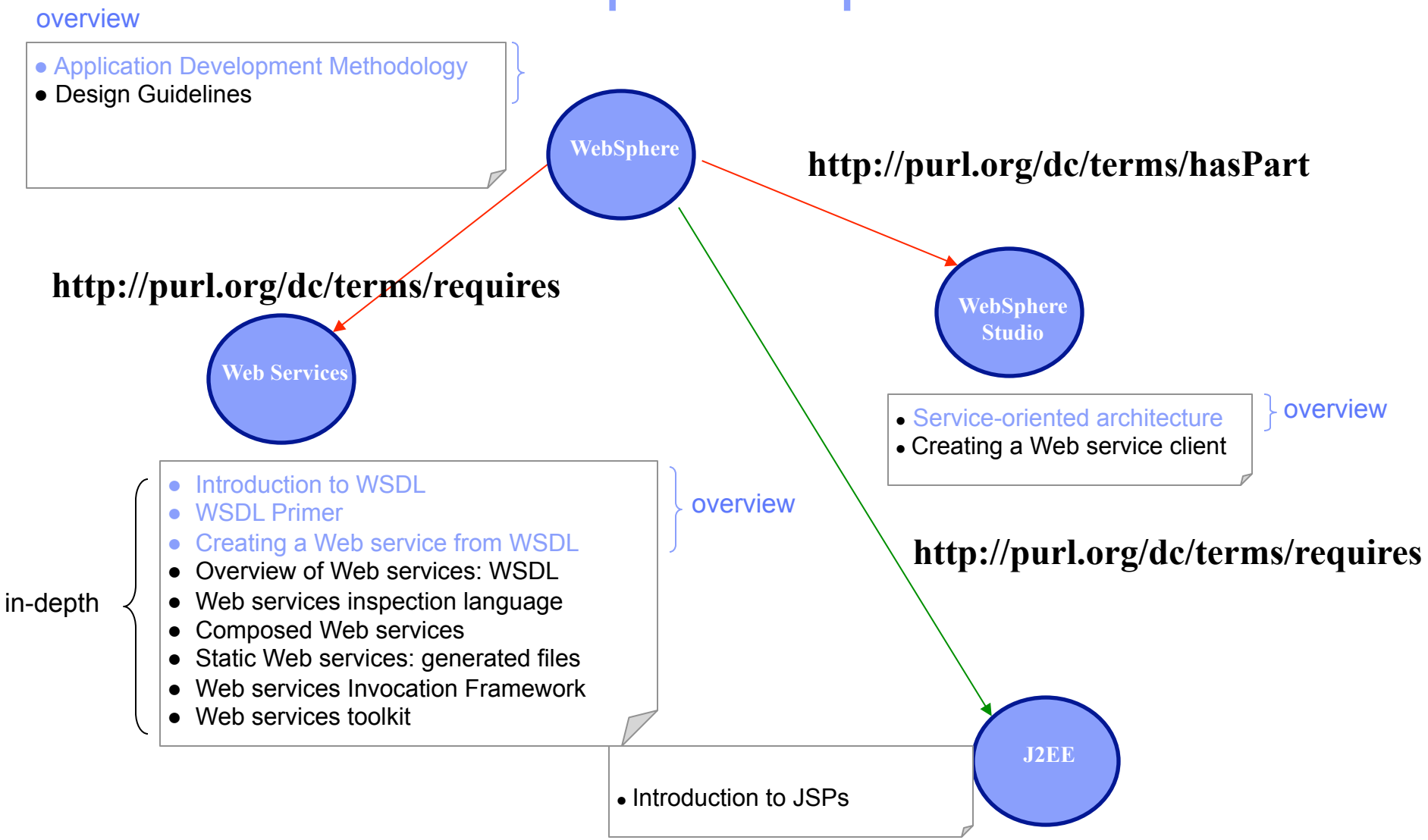
Topic Graph



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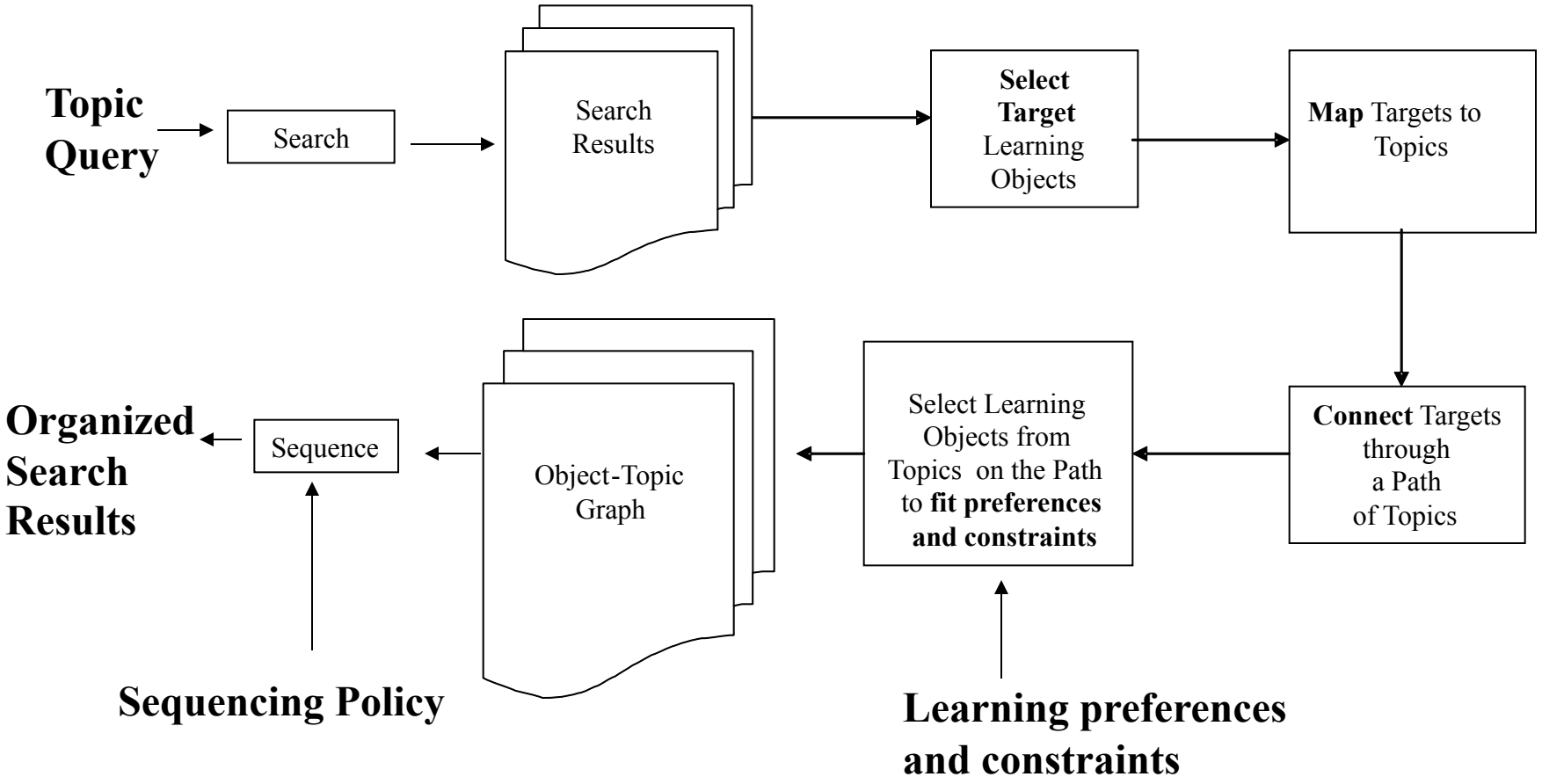
Dynamic Assembly Algorithm



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Required Learning Object Metadata

- **Topic** - *Taxon Path [9.2 Classification]* – The taxonomic path within a particular classification system. The “leaf” node in this taxonomic path is a node in the RDF graph
- **Instructional role** - *Learning Resource Type [5.2 Educational]* Potential roles for the learning object in future assemblies.
- **Duration -** *Typical Learning Time [5.9 Educational]* – Approximate or typical time it takes to work with or through the learning object

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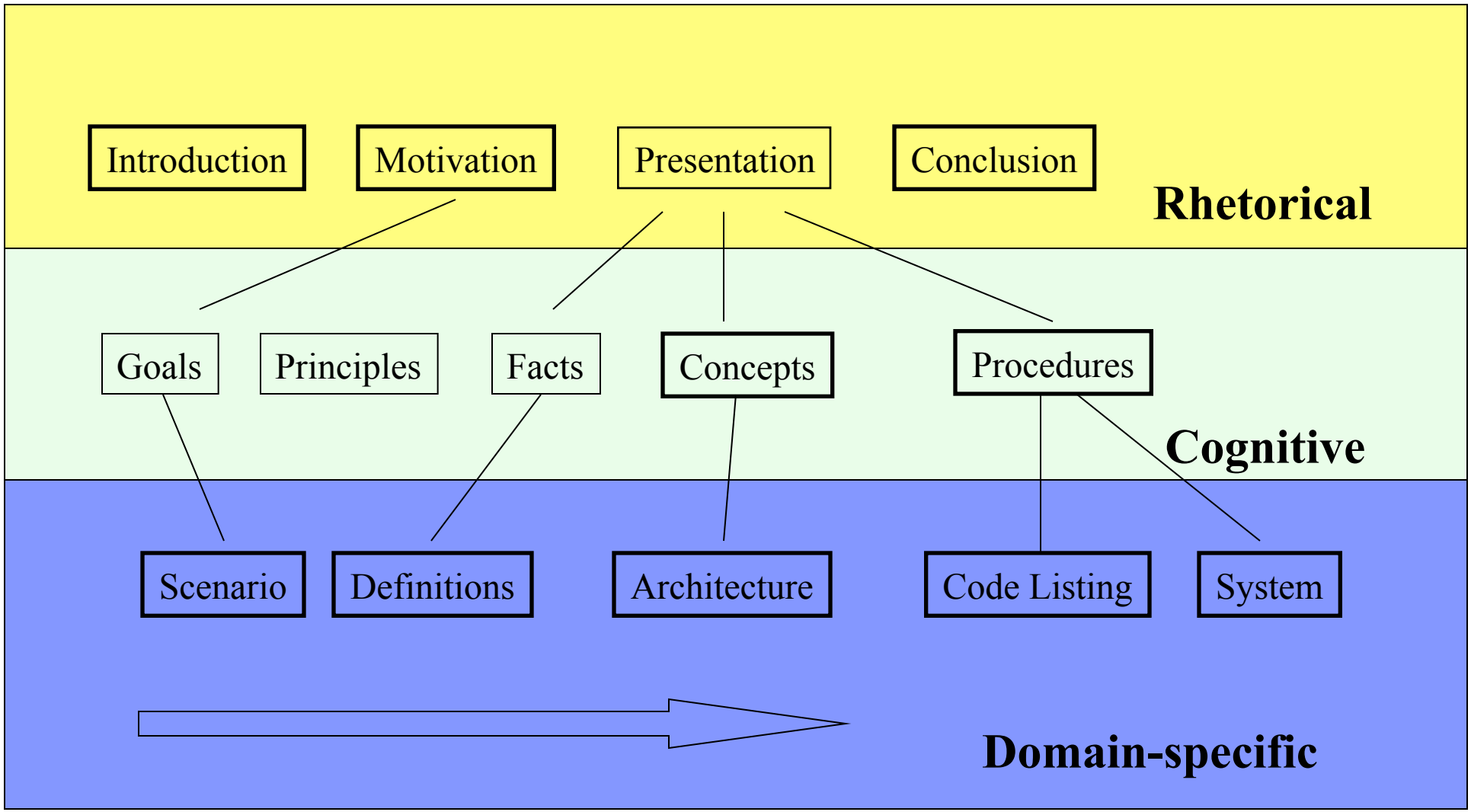
Instructional Roles



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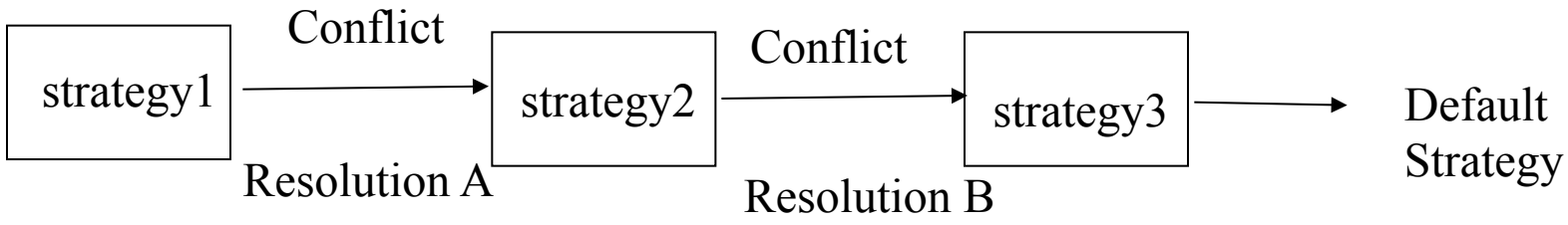
Sequencing Policy

- A **Sequencing Policy** is an ordered list of *Sequencing Strategies*.
- A **Sequencing Strategy** is a mechanism for ordering a collection of learning objects according to possible vocabulary for a particular metadata field.
- If a Sequencing Strategy cannot provide a total order of the learning objects, then there is a **Conflict Resolution Method**. For example, the next Sequencing Strategy in the policy could resolve the conflict. If none can resolve, there is a Default Strategy.



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Sample Sequencing Strategies

- **By Topic** – A ordering of topics in the Topic Graph.
- **By Instruction Role** – Reflecting the rhetorical structure of tutorial documents or a learning progression identified by a cognitive theory.
- **By Difficulty** – Easiest to most difficult, according to ratings.
- **By Media** – May want to list video clips before reference material.

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Dynamic Assembly vs. Search

	Search	Dynamic Assembly
Query	Keywords	Topic, Preferences, and Constraints
Key Operation	Retrieval	Crawling/Connecting
Target	Particular resource(s)	Collections (Web graphs, Courses)
Key Metric	Relevance	Coherence
Benefit	Finding information	Comprehension and Knowledge Integration

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Pilot Studies and Evaluation

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Pilot Studies

Domain	Authors	Users	Date	Feature	# of objects
WebSphere	Technical Publications Department	Software Integrators	3/2003	Learner-driven Assembly	400
Web Services	Subject Matter Experts	Consultants	8-10/2003	Dynamic Assembly + Sharing	500+
Portal Server	Course Developers	Business partners	3-9/2004	Recommendation	250+

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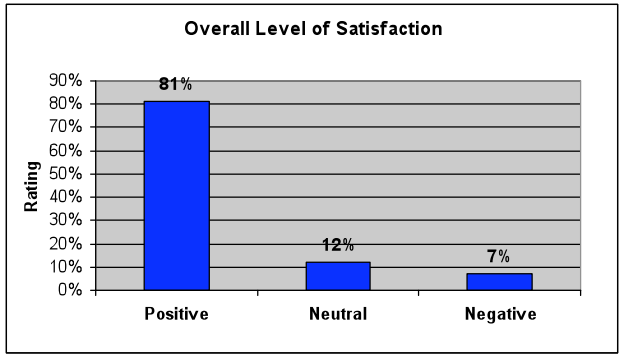
Survey Results



- *Satisfaction - 81%*

  Users like the concept of on-demand custom courses.

- *Ease of Use - 92%*

  A few users found custom courses were choppy and did not flow well.

- *Enhances knowledge or skills - 81%.*

  Some frustration with the limited scope of Redbooks in the trial.

- *Prefer this method of learning – 52%*

  People new to this subject commented it would be impossible learn without access to an instructor

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Lab Experiment: Search vs. Assembly

Query Only group vs. a Course Assembly group (randomized, 3 expert judges of performance on a 35 minute design task after 55 minutes of using the system)

- Normalizing for years of experience, the Course Assembly group **performed significantly better on the design task.**
- The Custom Course system was able to **adapt to user's unique needs**
  No learning object was used by every subject, 29 learning objects were used by only one subject
- The Course Assembly group spent **more time learning** and less (frustrating) time searching

  Query group issued more queries (2-12 queries, avg. 4) than the Assembly group (1-5 queries, avg. 2). The Query spent a shorter time on a large number of learning objects, while the Course Assembly group spent longer amounts of time on fewer learning objects (reading for comprehension).
- The Course Assembly group created more detailed design solutions than the Query group

  The total words for the Course Assembly group averaged 247 versus 128 for the Query group.

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Learning Content Development for DLE

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Learning Content Development Roles

- Metadata Tagger
  Understands source material (author/expert)
  Modularizes content, fills in metadata.

- Experience Designer
  Understands the desired learning experiences.
  Defines topic relationships and sequencing policy.
  Tests DLE repository against anticipated learning needs.

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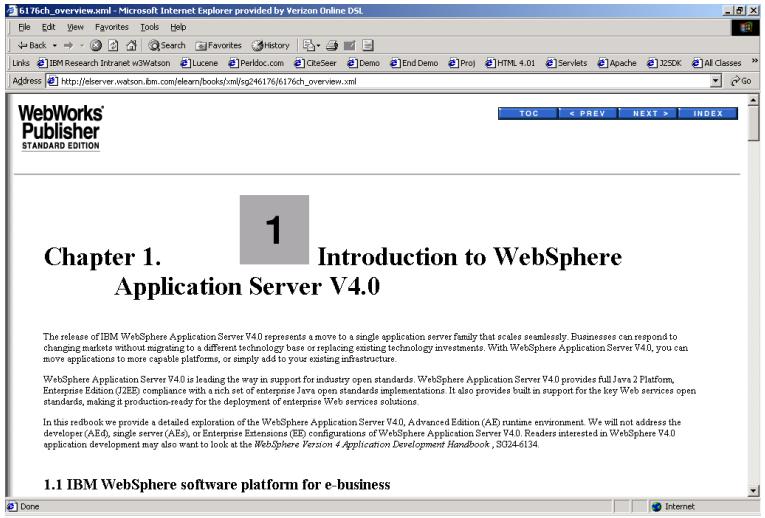
Example: IBM Redbooks

- 16 large IBM Redbooks
- A series of “how-to manuals”
- Focused on the Information Technology topics

- Over 5,000 pages of text and graphics
- 300,000 lines of text + 6,000 images
- Consistent presentation and writing style
- No digital rights issues



http://www.redbooks.ibm.com

Challenges:

- Multiple templates
- Logical chunks vary in size
- Dependencies/links
- Redundancies, coverage gaps

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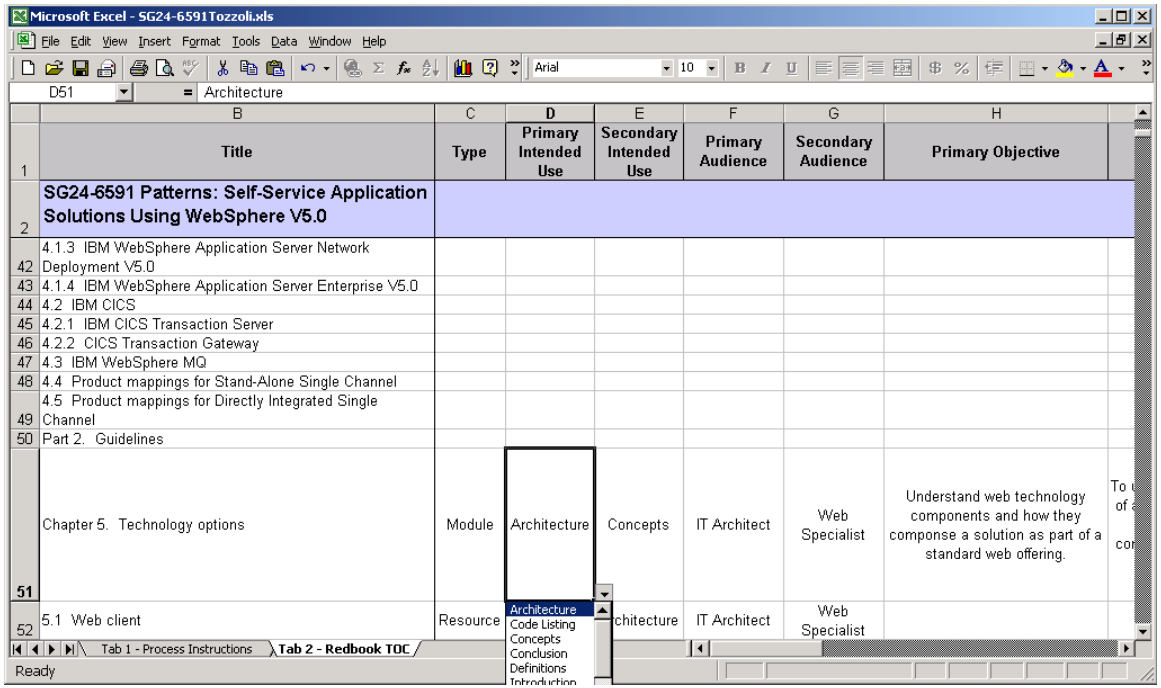
Pilot 2 – Redbooks – Metadata Tagging



- Locations (named anchors) are the finest level of modularization.
- XML content can be *included* or *excluded*
- 3 mandatory LOM fields and 8 optional
- 1 hr/100 pp. (5 to 10 hr/ book)

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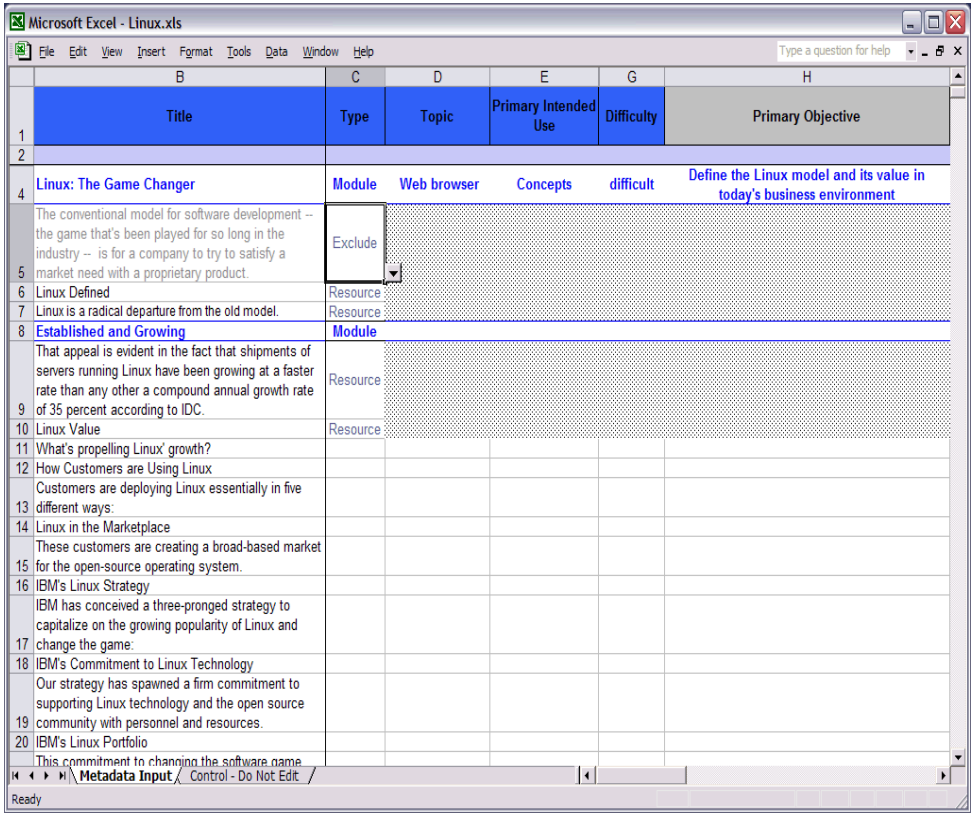
Example: Course Material (Presentations)



	B Title	C Type	D Topic	E Primary Intended Use	G Difficulty	H Primary Objective
1						
2						
4	Linux: The Game Changer	Module	Web browser	Concepts	difficult	Define the Linux model and its value in today's business environment
5	The conventional model for software development -- the game that's been played for so long in the industry -- is for a company to try to satisfy a market need with a proprietary product.	Exclude				
6	Linux Defined	Resource				
7	Linux is a radical departure from the old model.	Resource				
8	Established and Growing	Module				
9	That appeal is evident in the fact that shipments of servers running Linux have been growing at a faster rate than any other a compound annual growth rate of 35 percent according to IDC.	Resource				
10	Linux Value	Resource				
11	What's propelling Linux' growth?					
12	How Customers are Using Linux					
13	Customers are deploying Linux essentially in five different ways:					
14	Linux in the Marketplace					
15	These customers are creating a broad-based market for the open-source operating system.					
16	IBM's Linux Strategy					
17	IBM has conceived a three-pronged strategy to capitalize on the growing popularity of Linux and change the game:					
18	IBM's Commitment to Linux Technology					
19	Our strategy has spawned a firm commitment to supporting Linux technology and the open source community with personnel and resources.					
20	IBM's Linux Portfolio					
	This commitment to changing the software game					

- Embedded authoring into presentation tool
- Course developers can quickly convert an existing student guides with notes
- Single slides, notes, or groups of a few (2-10) of these objects become modules.
- Units are broken down to supporting objectives.
- 1 hr/unit (~10 hr/course)

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Simple Content XML wrapper for Composing embedded objects and XML fragments

```
<module>
   <chapter ….>
   <sect1 ….>                                  XML Fragments

  <html:object src="/content.htm">             Embedded object
       alternate text
   </html:object>

<indextext>                                    Indexable text (not rendered)
   text equivalent of embedded object
</indextext>

</module>
```


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Conclusions

- Dynamic Assembly is a new approach to “just-in-time” learning that utilizes IEEE LOM, IMS Content Packaging, and RDF Topic Graphs.
- IBM Dynamic Learning Experience (DLE) integrates search, assembly, sequencing, customization, archiving, and sharing.
- More research is needed to determine how to develop topic graphs and sequencing policies for learning object repositories supporting Dynamic Assembly.

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